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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/588,899	08/09/2006	Masayasu Miyata	9319A-001819/US/NP	4040
27572 7590 07/27/2009 HARNES, DICKEY & PIERCE, P.L.C. P.O. BOX 828 BLOOMFIELD HILLS, MI 48303				
EXAMINER				
CAO, PHAT X				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/588,899

**Applicant(s)**

MIYATA, MASAYASU

**Examiner**

Phat X. Cao

**Art Unit**

2814

**Period for Reply** -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 15 May 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,3-7,10 and 13-15 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3-7,10 and 13-15 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/S5108)  
Paper No(s)/Mail Date 4/15/09
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

1. The cancellation of claims 2, 8-9 and 11-12 in Paper filed on 5/15/09 is acknowledged.

***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 6 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 6 depends from claim 1. Claim 1 claims a gate insulating film material includes silicon, oxygen, hydrogen and at least one element other than silicon, oxygen and hydrogen (i.e., nitrogen, carbon, aluminum, hafnium, zirconium, and germanium). Claim 6 claims the gate insulating film material further includes deuterium. Therefore, in claim 6, the limitation having a gate insulating film material including both hydrogen and deuterium is not supported by the original disclosure. Evidently, page 31 (last paragraph) of Applicant's specification states that "replacing each of hydrogen atoms in the gate insulating film 3 with a deuterium atom". It is clear that the gate insulating film 3 includes either hydrogen or deuterium but not both as claimed in claim 6.

***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 3-5, 10, 13-14, and 15 are rejected under 35 U.S.C. 102(b) as being anticipated by Kobayashi et al (US 6,489,649).

Regarding claims 1 and 4, Kobayashi (Fig. 1) discloses a semiconductor device comprising: a base 204 including a semiconductor material; an insulating material 205 provided in contact with the base 204; and an electrode 207 provided on the insulating material 205; wherein the insulating material 205 includes silicon, oxygen, hydrogen and nitrogen (column 12, lines 40-47), the insulating material 205 having a region where B/A is in a range of 1.6 to 10 where a concentration of nitrogen in the region is defined as  $A = 2 \times 10^{20}$  atoms/cm<sup>3</sup> and a concentration of hydrogen in the region is defined as  $B = 5 \times 10^{20}$  atoms/cm<sup>3</sup> (column 12, lines 40-47).

Regarding claims 3, 5 and 15, Kobayashi (Fig. 1) further discloses that: the average thickness of the gate insulating film 205 is defined as Y, the region is located at a portion of the gate insulating film 205 which resides within a thickness of Y/10 of the gate insulating film 205 from the interface (column 9, lines 3-10); and the concentration of hydrogen and the concentration of nitrogen are measured by Second Ion Mass Spectrometry (column 8, lines 59-66).

Regarding claims 13 and 14, Kobayashi further discloses that semiconductor device of Fig. 1 is used for a memory cell device and for a liquid crystal display (column 5, lines 15-18).

Regarding claim 10, it has been held that where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, claimed properties or functions are presumed to be inherent. *In re Best*, 195 USPQ 430, 433 (CCPA 1977). In this case, because the gate insulating film of claimed device and the gate insulating film of Kobayashi's device both have substantially identical in structure and composition, claimed property of having the maximum leakage current passing through the gate insulating film being  $2 \times 10^{-8}$  A/cm<sup>2</sup> or less when the electric field intensity in the gate insulating film being 3 MV/cm is presumed to be inherent.

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al (US 6,489,649).

Kobayashi further disclose the thickness of the gate insulating film 205 is 12 nm (column 7, lines 46-50), but not 10 nm as claimed.

However, it has been held that a *prima facie* case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corporation of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985). Therefore, it would have been obvious to change the thickness of the gate insulating film 205 of Kobayashi from 12 nm to 10 nm as claimed because the thickness of the gate insulating film can be optimized during routine experimentation and the changing of such thicknesses would not change the function of the gate insulating film.

8. Claims 1, 3-4, 7, 10, 13-14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kusunoki et al (US 2002/0066934).

Regarding claims 1 and 4, Kusunoki (Fig. 11) discloses a semiconductor device comprising: a base 1 including a semiconductor material; an insulating material 22 provided in contact with the base 1; and an electrode 5 provided on the insulating material 22; wherein the insulating material 22 includes silicon, oxygen, hydrogen and nitrogen (par. [0074]), the insulating material 22 having a region where B/A is in a range of 1.2 where a concentration of nitrogen in the region is defined as  $A = 2.5 \times 10^{20}$  atoms/cm<sup>3</sup> and a concentration of hydrogen in the region is defined as  $B = 3 \times 10^{20}$  atoms/cm<sup>3</sup> (par. [0074]).

Kusunoki discloses that the value of the region B/A is 1.2 but does not disclose that the value of the region B/A is 1.6 as claimed.

However, there is no evidence of record to indicate that the value of the region B/A of the gate insulating film being equal or higher than 1.6 will achieves unexpected

results over the value of the region B/A of the gate insulating film being equal 1.2. The examiner specifically notes page 19 (first paragraph) of Applicant's specification. This page states that "B/A ... more preferably it is 2 or less". This applicant's specification appears to support the examiner's position that the value of the region B/A having value being equal or higher than 1.6 does not perform different than the value of the region B/A having value being equal 1.2 as taught by Kusunoki. Furthermore, it has been held that a *prima facie* case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corporation of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to form the value of region B/A being 1.2 as suggested by Kusunoki or 1.6 as claimed because the value of region B/A can be optimized during routine experimentation by changing the concentration of nitrogen or hydrogen, and the same effects of improving an efficiency of injection of channel hot electrons and suppressing of an interface level would result (see par. [0026] of kusunoki).

Regarding claims 3, 7 and 15, Kusunoki (Fig. 11) further discloses that the average thickness of the gate insulating film 22 is 10nm (par. [0074]), the region is located at a portion of the gate insulating film 22 which resides within the thickness of the 10nm/10 of the gate insulating film 22 from the interface.

Regarding claim 10, it has been held that where the claimed and prior art products are identical or substantially identical in structure or composition, or are

produced by identical or substantially identical processes, claimed properties or functions are presumed to be inherent. In re Best, 195 USPQ 430, 433 (CCPA 1977). In this case, because the gate insulating film of claimed device and the gate insulating film of Kusunoki's device both have substantially identical in structure and composition, claimed property of having the maximum leakage current passing through the gate insulating film being  $2 \times 10^{-8}$  A/cm<sup>2</sup> or less when the electric field intensity in the gate insulating film being 3 MV/cm is presumed to be inherent.

Regarding claims 13-14, Kusunoki further discloses that an electronic apparatus comprising an electronic device of flash EEPROM (see Fig. 54, and par. [0008]).

9. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kusunoki et al in view of Hori et al (US 6,215,163).

Kusunoki does not disclose the concentration of hydrogen and the concentration of nitrogen are measured by Secondary Ion Mass Spectrometry (SIMS).

It is noted that the process limitations (i.e., measured by means of Secondary Ion Mass Spectrometry ) recited in a "product by process" claim would not carry patentable weight in a claim drawn to structure because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985). However, Hori teaches the known feature of using Secondary Ion Mass Spectrometry to measure the concentration of hydrogen and the concentration of nitrogen in the silicon oxynitride insulating layer (see Fig. 4 and column 8, lines 8-13).

10. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi et al or Kusunoki et al in view of Mitani et al (US 2002/0140043) .



Neither Kobayashi nor Kusunoki discloses that each hydrogen atom in a part of the hydrogen atoms is replaced by a deuterium atom.

However, Mitani (Figs. 6-7) teaches that the Si-H bond which is especially weak from an electrical viewpoint is diminished in the vicinity of the interface with the silicon substrate, so that hydrogen is substituted by deuterium so as to form Si-D bonds which are electrically robust (par. [0053]). Therefore, it would have been obvious to modify the gate insulating film of Kobayashi or Kusunoki by replacing hydrogen atoms with deuterium atoms in order to form Si-D bonds which are electrically robust.

#### ***Response to Arguments***

11. Applicant's arguments with respect to amended claims have been considered but are moot in view of the new ground(s) of rejection.

#### ***Conclusion***

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phat X. Cao whose telephone number is (571)272-1703. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571)272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/P. X. C./  
Primary Examiner, Art Unit 2814

/Phat X. Cao/  
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